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Coal Combustion Waste Impoundment

Dam Assessment Report

Site 9
Mayo Ash Pond
Progress Energy
Roxboro, North Carolina

Project # 0-381

Assessment of Dam Safety
Coal Combustion Surface Impoundments
For the REAC Program

Prepared for:

Lockheed Martin Services, Inc.
Edison, New Jersey
For
United States Environmental Protection Agency

Prepared by:

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Charlotte, North Carolina

Under Contract Number: EP-C-04-032: REAC

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INTRODUCTION

The release of over 5 million cubic yards of coal ash from the Tennessee Valley Authority's Kingston, Tennessee, facility in December 2008 serves as an important reminder of the need for our continued diligence on disposal units where coal combustion wastes are managed. The coal ash from the facility flooded more than 300 acres of land, damaging homes and property. It is critical that we all work to the best of our abilities to prevent a similar catastrophic failure and resultant environmental damage. One of the first steps in this effort is to assess the stability and functionality of the impoundments and similar units that contain coal combustion residuals and by-products to determine if and where corrective measures may be needed and then to carry out those measures as expeditiously as possible.

This report for the Progress Energy Mayo facility assesses the stability and functionality of the subject management unit. This evaluation is based on a site assessment conducted on Friday, June 3, 2009 by Dewberry & Davis, Inc.

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management unit) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety)

In February 2009, the EPA sent letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion waste. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

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The purpose of this report is to evaluate the condition and potential of waste release from the selected High Hazard Potential management units. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided via telephone communication with the management unit owner.

EPA sent two engineers, one of whom was a professional engineer (PE), for a one-day site visit. The two-person team met with the owner of the management unit to discuss the engineering characteristics of the unit as part of the site visit. During the site visit, the team collected additional information about the management unit to be used in determining the hazard potential classification of the management unit(s).

Factors considered in determining the hazard potential classification of the management units(s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s). The team considered criteria in evaluating dams under the National Inventory of Dams, in making these determinations.

LIMITATIONS

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion waste management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from our one-day site visit and review of technical documentation provided by Progress Energy.

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

The embankment and spillway appear to be structurally sound.

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Adequate freeboard and capacity exist to safely pass the design storm.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

Supporting technical documentation is adequate.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

The descriptions provided are appropriate.

1.1.5 Conclusions Regarding the Field Observations

Embankments visually appear to be well maintained, safe, and structurally sound. There are no apparent indications of any unsafe conditions.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

Maintenance and methods of operation are adequate.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

Surveillance and monitoring program are adequate.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

Facility is SATISFATORY for continued safe and reliable operation. No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

None appear warranted at this time.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

None appear warranted at this time; however, a dam break analysis should be performed and incorporated into existing emergency dam failure procedures.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

None appear warranted at this time.

1.2.4 Recommendations Regarding the Description of the Management Unit(s)

None appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

None appear warranted at this time.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

It is recommended that:

- Precaution be taken to not mow the embankment when wet or to take necessary measures to not create ruts perpendicular to the embankment slope;
- Grass, or similar shallow rooted herbaceous vegetative cover, needs to be established in bare areas where soil is visible; and
- Under drain outlets be protected with small-animal guards attached with a hinge allowing for unobstructed flow (a removable screen placed over the front of the weir box is an acceptable alternative providing it is affixed with a mechanism providing for unobstructed flow should clogging occur).

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1.2.7 Recommendations Regarding the Surveillance and Monitoring Program

Continue current program.

1.2.8 Recommendations Regarding Continued Safe and Reliable Operation

Perform dam break analysis and develop an emergency action plan in the event of dam failure.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Javier Garcia – Environmental Protection Agency (EPA)
Autumn Hoban-Romanski – North Carolina Department of Natural Resources (NCDENR)
Dulcie Phillips – Progress Energy Carolinas (PEC)
Bill Forster - Progress Energy Carolinas (PEC)
Justin Story – Dewberry & Davis, Inc. (DDI)
Frederic Shmurak – Dewberry & Davis, Inc. (DDI)

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on June 3, 2009.

Frederic M. Shmurak

Frederic M. Shmurak, PE (NC # 027071)

Justin Story

Justin Story, Civil Engineer

NORTH CAROLINA
PROFESSIONAL
SEAL
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ENGINEER
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2.0 DESCRIPTION OF THE COAL COMBUSTION WASTE MANAGEMENT UNIT(S)

2.1 LOCATION

The Mayo Electric Generating Plant is located approximately 10 miles northeast of Roxboro, North Carolina in Person County. The ash pond dam is approximately 1,000 feet south of the North Carolina-Virginia state line. See Appendix A – Doc 10.

2.2 SIZE AND HAZARD CLASSIFICATION

Based on data provided by Progress Energy Carolinas, Inc. (PEC), the ash pond dam is approximately 90 feet height, 2,300 feet long and 400 feet wide at the base (See Table 2.4.1). The current pond storage capacity is 4,100 acre-feet and the surface area is 140 acres. It is estimated that the total pond storage capacity when the material is at the top of the dam is approximately 6,000 acre-feet. The classification for size, based on the height of the dam and storage capacity, is Intermediate in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria.

Table 2.2a USACE ER 1110-2-106
Size Classification

Category	Impoundment Storage (Ac-ft)	Impoundment Height (ft)
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

This dam has been established Significant as a Hazard Classification. Per the Federal Guidelines for Dam Safety dated April 2004, Dams assigned the significant hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.

Table 2.2b FEMA Federal Guidelines for Dam Safety
Hazard Classification

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

2.3 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

Per Progress Energy, this ash pond contains fly ash, bottom ash, boiler slag, categorical low volume wastewater, coal pile runoff, ash sluice water/cooling tower blowdown and storm water. It was also noted that flue gas emission control residuals will be introduced to the lower area of the pond in 2009. The surface area for the pond is approximately 140 acres. The current storage capacity is approximately 4,100 acre-feet. The volume of the material currently stored is approximately 2,435 acre-feet based on an estimate in July 2007 made by PEC.

Table 2.3: Amount of Residuals and Maximum Capacity of Unit	
	Mayo Ash Pond Dam
Surface Area (acre)	140
Current Storage Capacity (acre-feet)	4,100
Total Storage Capacity (acre-feet)	6,000
Crest Elevation (feet)	490
Normal Pond Level (feet)	480

Data taken from PEC Questionnaire, See Appendix A-Doc 04.

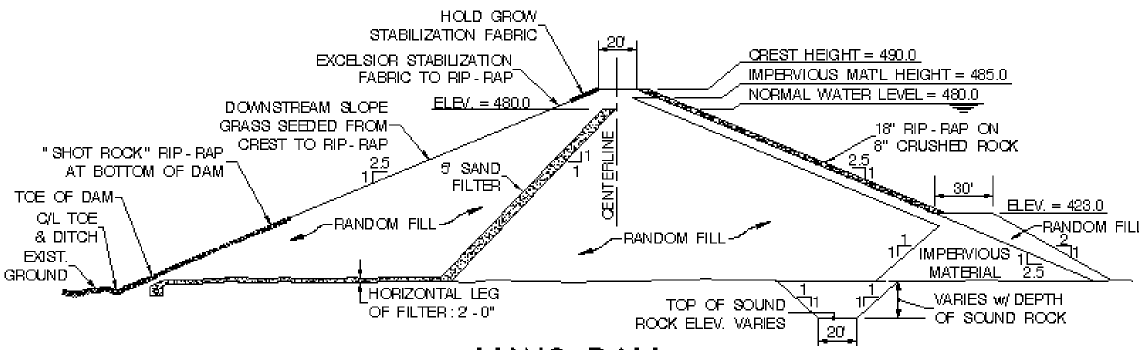
2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment Dam

The dam embankment is a composite of compacted random earth fill and rock fill with impervious membrane placed at the upstream face, a random fill toe, a chimney drain system and a sand filter toe drain to control seepage. The embankment upstream and downstream slopes are 2.5(H):1(V); please refer to Appendix A – Doc 02 for dam geometry, plan, profile and sections. The following figure of the Mayo Dam Typical Design Section is representative of the configuration of the management unit.

Table 2.4.1: Summary of Dam Dimensions and Size	
	Mayo Ash Pond Dam
Dam Height	90'
Crest Width	20'
Length	2,300'
Side Slopes (upstream)	2.5:1
Side Slopes (downstream)	2.5:1
Hazard Classification	Significant

Data taken from PEC Questionnaire, See Appendix A-Doc 04.



MAYO DAM

TYPICAL DESIGN SECTION
NOT TO SCALE

2.4.2 Outlet Structures

The outlet works consist of a concrete broad crested weir, located within a stilling pond, in the eastern portion of the reservoir. Water is conveyed over the weir through an open channel and is discharged into the Mayo Reservoir. The stilling pond is formed by an earthen dike with a CMP riser and skimmer within the reservoir. Details of the outlet works were not provided, and the structure could not be accessed for measurement during the field reconnaissance.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

No critical infrastructure within five miles down gradient was observed using Google Earth Images dated 2009. The land use downstream is primarily agriculture and farm land. There is one gravel secondary road immediately downstream of the dam and few unimproved road crossings downstream. See Appendix A – Doc 10.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS AND INCIDENTS

3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE MANAGEMENT UNIT(S)

PEC provided the 5-Year Independent Consultant Inspection Report, by Law Engineering & Environmental Services, dated December 22, 1999 and by MACTEC, dated June 9, 2004 for the Ash Pond facility. The independent inspection is performed at 5-year intervals as required by the North Carolina Utilities Commission (NCUC) and not licensed by the Federal Energy Regulatory Commission. The reports concluded that the Ash Pond facility had no significant deficiencies or indications of potential significant deficiencies which would endanger the safety of the structures and that no serious deficiencies were observed in maintenance or methods of operation, quality and adequacy of surveillance.

PEC has indicated that the 2009 Comprehensive five-year inspection has been started, field work completed and that the final report will be issued sometime during the fall of 2009.

3.2 SUMMARY OF LOCAL, STATE AND FEDERAL ENVIRONMENTAL PERMITS

The facility is under regulation by the NCUC. No local, state or federal permits were provided to the dam assessors; however, PEC indicated that the discharge from the facility is regulated under an National Pollution Discharge Elimination System Permit and the embankment received an Authorization to Construct Permit issued by NC Division of Environment and Natural Resources (NC DENR) as well as a NC DENR Division of Water Quality 401 / USACE 404 Permit for Construction. NC DENR Raleigh Regional Office, Surface Water Protection Section Division Water Quality Section has provided a Memorandum dated August 18, 2009 indicating that the facility was in compliance with NPDES Wastewater Permit No. NC0038377 (See Appendix A – Doc 11).

3.3 SUMMARY OF SPILL/RELEASE INCIDENTS (IF ANY)

No evidence of prior spills/releases, failures, or patchwork was observed on the earthen embankment during the visual site assessment and no documents or statements were provided to the dam assessor that indicates prior releases, failures, or patchwork repairs have occurred.

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4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

Construction began for the ash pond dam in August of 1981 and was completed in October of 1982. The Mason C. Day Company was the contractor and S&ME performed the testing and inspection services. The ash pond was designed by Carolina Power & Light and Mr. William Wells, P.E.

The dam assessor did not meet with, or receive documentation from, the design engineer of record regarding foundation preparation. Furthermore, no construction documentation was provided to determine if foundation preparation was in conformity with the design assumptions.

The impoundment embankment was not built over wet ash or slag. Based on the Mayo E.G.P. Ash Pond Dam Geological Profile (Appendix A – Doc 02, Exhibit 27), no ash or slag was present at the time of embankment design or construction. Mayo E.G.P. Ash Pond Dam Typical Section (Appendix A – Doc 02, Exhibit 8), indicates portions of the embankment foundation are designed to be keyed into sound rock; however, no documentation has been provided to verify construction was in conformance with the design.

4.1.2 Significant Changes/Modifications in Design since Original Construction

The original design has not been modified.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No information was provided regarding repairs or rehabilitation. Rip rap was placed on the bottom third of the downstream slope in 1984 to prevent erosion. Soil stabilization fabric and seeding were placed on the upper two thirds of the downstream slope. The V-notch weirs at the internal drains were removed in 1993 and a graduated cylinder or bucket and stopwatch method of measuring seepage was substituted for weir plate measurement.

No evidence of prior releases, failures, or patchwork was observed on the earthen embankment during the visual site assessment and no documents or statements were provided to the dam assessor that indicates prior releases, failures, or patchwork repairs have occurred.

4.2 SUMMARY OF OPERATIONAL HISTORY

4.2.1 Original Operational Procedures

The dam was designed and operated for reservoir sedimentation and sediment storage; specifically, fly ash, bottom ash, boiler slag and flue emission control residuals. Plant process waste water slurrying coal combustion waste and stormwater runoff from the facility are discharged into the reservoir, inflow water is treated through gravity settling and deposition, and treated process water and stormwater runoff are discharged through an unregulated overflow outlet structure.

4.2.2 Significant Changes in Operational Procedures since Original Startup

No operational procedures have changed.

4.2.3 Current Operational Procedures

Original operational procedures are in effect.

4.2.4 Other Notable Events since Original Startup

No additional information was provided.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry & Davis, Inc. performed a site visit on Friday, June 3rd, 2009. The site visit began at 10:00 AM. Weather was a sunny, hot, clear day. The embankment had just recently been mowed as evidenced by widespread deposits of grass on the embankment. The overall assessment of the dam was that it was in satisfactory condition and no significant findings were noted. Please refer to photographs in Appendix B.

5.2 EARTH EMBANKMENT DAM

5.2.1 Crest

The crest had no signs of any depressions, tension cracks or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

5.2.2 Upstream Slope

The upstream slope is protected with rip rap and some vegetation. Scarps, sloughs, depressions or other indications of slope instability or signs of erosion were not observed.

5.2.3 Downstream Slope and Toe

The downstream slope was grassed and no deep rooted vegetation was noted. Approximately the bottom one-third of the embankment was covered with rip rap in 1984 because a significant amount of erosion had been occurring. There were isolated areas of minor rutting, which likely resulted from the wheeled tractor that mowed the grass. Scarps, sloughs, depressions or other indications of slope instability or signs of erosion or uncontrolled seepage were not observed.

5.2.4 Abutments and Groin Areas

Erosion or uncontrolled seepage was not observed along either groin. The abutments and groin areas appeared to be in excellent condition.

5.3 OUTLET STRUCTURES

5.3.1 Overflow Structure

The primary overflow structure was observed to be working properly, discharging flow from the pond, and visually appeared to be in satisfactory condition.

5.3.2 Outlet Conduit

There is no outlet conduit present.

5.3.3 Emergency Spillway (If Present)

No emergency spillway is present.

5.3.4 Low Level Outlet

No low level outlet is present.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Floods of Record

Progress Energy stated the highest pond elevation they have observed was approximately 1.7 feet above the designed pond elevation of 480 feet during Hurricane Fran on September 5, 1996. Local rain gauge data reportedly recorded 6" of rainfall in 24 hours. This rain event would have left approximately 8.5 feet of freeboard based on the provided top of dam elevation at 490 feet. See Independent Consultant Inspection dated December 1999 under Appendix A – Doc 01 (page 17). No documentation has been provided to the dam assessor to verify this observation.

6.1.2 Inflow Design Flood

According to FEMA Federal Guidelines for Dam Safety, current practice in the design of dams is to use the Inflow Design Flood (IDF) that is deemed appropriate for the hazard potential of the dam and reservoir, and to design spillways and outlet works that are capable of safely accommodating the floodflow without risking the loss of the dam or endangering areas downstream from the dam to flows greater than the inflow. The recommended IDF or spillway design flood for a significant hazard intermediate sized structure (See section 2.2), in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria is the ½ PMF to PMF (See Table 6.1.2).

Table 6.1.2: USACE Hydrologic Evaluation Guidelines
Recommended Spillway Design floods

Hazard	Size	Spillway Design Flood
Low	Small	50 to 100-yr frequency
	Intermediate	100-yr to ½ PMF
	Large	½ PMF to PMF
Significant	Small	100-yr to ½ PMF
	Intermediate	½ PMF to PMF
	Large	PMF
High	Small	½ PMF to PMF
	Intermediate	PMF
	Large	PMF

The Probable Maximum Precipitation (PMP) is defined by American Meteorological Society as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. The National Weather Service (NWS) further states that in consideration of our limited knowledge of the complicated processes and interrelationships in storms, PMP values are identified as estimates. The NWS has published application procedures that can be used with PMP estimates to develop spatial and temporal characteristics of a Probable Maximum Storm (PMS).

A PMS thus developed can be used with a precipitation-runoff simulation model to calculate a probable maximum flood (PMF) hydrograph.

The ash pond was designed to store the PMP. The PMP was determined using HMR-51 and is approximately 39.5 inches of rainfall in a 24 hour period. See Independent Consultant Inspection dated December 1999 under Appendix A – Doc 01 (page 20). Although no documentation had been provided to indicate that dam had been modeled using a PMF inflow hydrograph, it should be noted that the contributing watershed is limited to the immediate area of the facility and the dam had been modeled to store the PMP; therefore, the facility is in compliance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria.

6.1.3 Spillway Rating

No spillway rating was provided.

6.1.4 Downstream Flood Analysis

No downstream flood analysis was provided.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting technical documentation is adequate.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the Independent Consultant Inspection dated December 1999 under Appendix A – Doc 01 (page 20), a maximum rise for the water was 7.2 feet above the normal pond elevation of 480 feet for the design storm. The freeboard elevation is approximately 2.8 feet when water is at the design storm. Adequate freeboard appears to exist in order to safely store and pass the design flood.

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7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

Static and seismic loading were analyzed. See Table 7.1.4 for results.

7.1.2 Design Properties and Parameters of Materials

See Table 7.1.2

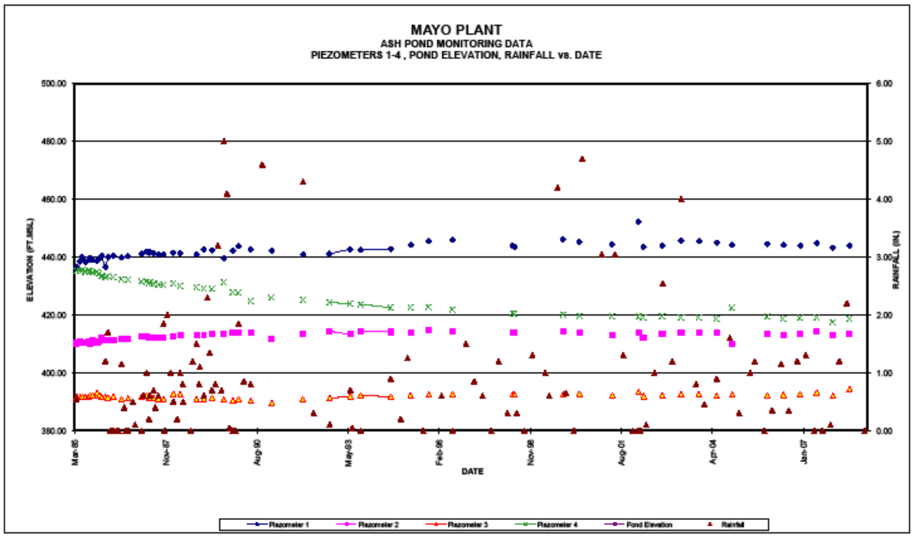
Table 7.1.2: Design Properties and Parameters of Materials

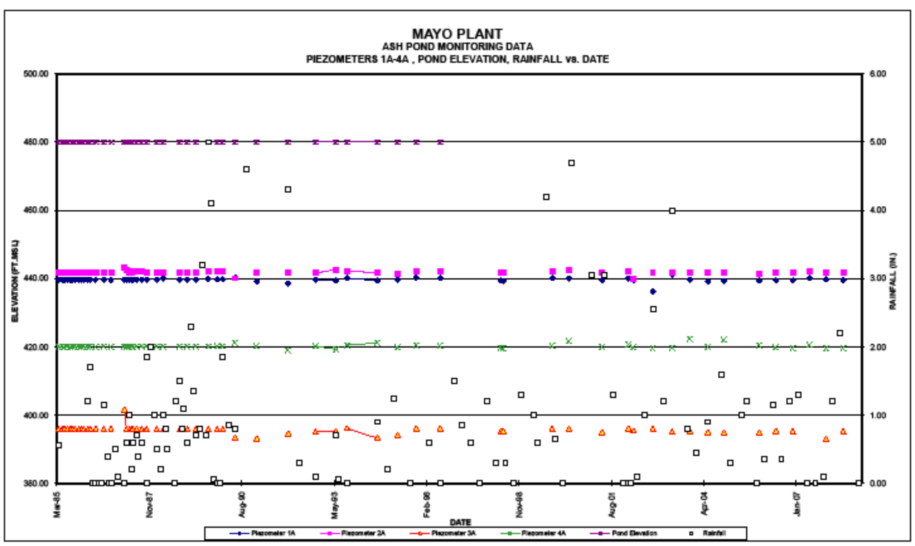
Borrow Material Type	Cohesion C (psf)	Friction Angle ϕ
Impervious	0	24
Random	0	30

Data taken from Independent Consultant Inspection Report provided by Progress Energy dated December 1999, see Appendix A – Doc 01 (Page 19 & Exhibit 28).

7.1.3 Uplift and/or Phreatic Surface Assumptions

No uplift calculations were provided. Based on the stability model (Appendix A – Doc 01, Exhibit 29), the assumed phreatic surface is consistent with the piezometer readings. Piezometers 1A, 2A, 3A and 4A were designed to remain dry when the sand filter and toe drain are working properly which remains consistent with the reports provided by Progress Energy. The following charts represent piezometer readings recorded from March 1985 to May 2009, for piezometers 1, 2, 3 and 4 as well as 1A, 2A, 3A and 4A respectively, and indicate a steady and consistent trend.


MAYO PLANT
ASH POND MONITORING DATA
PIEZOMETERS 1-4 , POND ELEVATION, RAINFALL vs. DATE
ELEVATION (FT.MSL)
RAINFALL (IN.)
500.00
480.00
460.00
440.00
420.00
400.00
380.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Mar-85
Nov-87
Aug-90
May-93
Feb-96
Nov-98
Aug-01
Apr-04
Jan-07
DATE
Piezometer 1
Piezometer 2
Piezometer 3
Piezometer 4
Pond Elevation
Rainfall


MAYO PLANT
ASH POND MONITORING DATA
PIEZOMETERS 1A-4A , POND ELEVATION, RAINFALL vs. DATE
ELEVATION (FT.MSL)
RAINFALL (IN.)
500.00
480.00
460.00
440.00
420.00
400.00
380.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Mar-85
Nov-87
Aug-90
May-93
Feb-96
Nov-98
Aug-01
Apr-04
Jan-07
DATE
Piezometer 1A
Piezometer 2A
Piezometer 3A
Piezometer 4A
Pond Elevation
Rainfall

7.1.4 Factors of Safety and Base Stresses

See Table 7.1.4

Table 7.1.4: Factors of Safety	
	Mayo Ash Pond Dam
Static Loading	1.52
Seismic Loading (a=0.1g)	1.12

Data taken from Independent Consultant Inspection provided by Progress Energy dated December 1999, see Appendix A – Doc 01 (Page 19).

7.1.5 Liquefaction Potential

No liquefaction potential data was submitted. Foundation soil conditions do not appear susceptible to liquefaction.

7.1.6 Critical Geological Conditions and Seismicity

No critical geological conditions are present. The site lies in a relatively inactive seismic area; however, based on USGS Seismic-Hazard Maps for the Conterminous United States, dated 2005, the facility is located in an area anticipated to experience a 0.08g acceleration with a 2-percent probability of exceedance in 50-years. A design acceleration of 0.1g was used for this site which meets the standards for this region (Appendix A – Doc 01, Page 4). Additional geological conditions are included in Appendix A – Doc 08. The following paragraphs describe the prevailing geological conditions found in the vicinity of the site:

The facility is located within the Piedmont Physiographic Province in North Carolina. The Piedmont Physiographic Province generally consists of rolling, well-rounded hills and ridges. The specific site is further classified by its location in the Milton Geologic Belt, near the border with the Carolina Slate Belt. The rock within the Milton Belt is composed of gneiss, schist, and metamorphosed intrusive rocks. The belt is best known for crushed stone (utilized for aggregate and building construction).

The rock within the pond and dam impoundment area is classified as CZfv, per the Geologic Map of North Carolina. The CZfv classification represents a Felsic Metavolcanic rock (metamorphosed dacitic to rhyolitic flows and tuffs, light gray to greenish gray; minor mafic and intermediate metavolcanic rock). Directly west of the dam embankment and pond edge, the rock is classified as CZfg, which represents a Felsic Mica Gneiss (interlayered with biotite and hornblende gneiss and schist).

Two faults are located in the vicinity of the ash pond and dam impoundment. The Dan River Fault Zone is located approximately forty (40) miles West of the ash pond and dam impoundment and the Nutbush Creek Fault is located approximately fifty (50) miles East of the ash pond and dam impoundment. Additionally, a geological dike is located approximately ten (10) to fifteen (15) miles Southeast of the ash pond and dam impoundment.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Structural stability documentation is adequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall, the structural stability of the embankment appears to be satisfactory based on the following parameters:

- The internal drains are flowing clear and at a consistent rate which is a good indication internal soil piping is not occurring;
- There were no indications of scarps, sloughs, depressions or bulging anywhere along the dam;
- Boils, sinks or uncontrolled seepage was not observed along the slopes, groins or toe;
- The crest appeared free of depressions; and
- The computed factors of safety comply with accepted criteria.

Based on the previous assessments/inspections provided by Law Engineering & Environmental Services, MACTEC and Progress Energy, our assessment is consistent with historical observations.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATIONAL PROCEDURES

Operational procedures are adequate. The facility is operated for reservoir sedimentation and sediment storage; specifically, fly ash, bottom ash, boiler slag and flue emission control residuals. Coal combustion process waste water and stormwater runoff from the facility are discharged into the reservoir, inflow water is treated through gravity settling and deposition, and treated process water and stormwater runoff is discharged through an unregulated overflow outlet structure.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Maintenance procedures are adequate based upon the following:

- Grassed areas are routinely mowed;
- Deep rooted vegetation is removed from the rip-rap slopes;
- Spillways and outlets are maintained; and
- Debris at spillways and outlets are removed as needed.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATION

8.3.1 Adequacy of Operational Procedures

Operation procedures are adequate.

8.3.2 Adequacy of Maintenance

The maintenance program is adequate; however, it is recommended that:

- Precaution be taken to not mow the embankment when wet or to take necessary measures to not create ruts perpendicular to the embankment slope;
- Grass, or similar shallow rooted herbaceous vegetative cover, needs to be established in bare areas where soil is visible; and
- Under drain outlets be protected with small-animal guards attached with a hinge allowing for unobstructed flow (a removable screen placed over the front of the weir box is an acceptable alternative providing it is affixed with a mechanism providing for unobstructed flow should clogging occur).

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Per Progress Energy, the surveillance program is as follows:

Monthly Inspections:
Beginning in June, 2009 PEC personnel will begin monthly visual inspections.

Semi-Annual Inspections:
"Semi-annual inspections that include visual inspections and data gathering to detect any problems at an early stage of development are conducted by plant personnel." See Appendix A – Doc - 05 for copy of the February 12, 2009 inspection report.

Annual Inspections:
"Annual inspections are conducted by a third-party professional engineering contractor. The engineering firms that conduct the inspections have expertise in geotechnical and civil engineering." See Appendix A – Doc - 06 for copy of the March 6, 2008 inspection report.

Five-year Inspections:
"Comprehensive five-year inspections are conducted by a third-party professional engineer contractor. The engineering firms that conduct the inspection have expertise in geotechnical and civil engineering." See Appendix A – Doc 07 for copy of the June 9, 2004 inspection report.

PEC has indicated that the 2009 Comprehensive five-year inspection has been started, field work completed and that the final report will be issued sometime during the fall of 2009.

9.2 INSTRUMENTATION MONITORING

9.2.1 Instrumentation Plan

A seepage collector box is located at the toe of the slope at the outlets of the internal drains. Points of seepage flow are measured or estimated. Internal drain outlets are visually inspected for proper function. A graduated beaker and stop watch are used to determine flowrate. Four pairs of piezometers are located within the downstream slope. For piezometer readings, a water level indicator probe is used, which is lowered within the monitoring well until water is reached, and the distance is recorded. Please refer to Appendix A, Doc 02 Exhibit 30 Mayo Electric Generating Plant 5 Year Dam Safety Inspection – 1989 Ash Pond Dam - Piezometers for locations of the piezometers.

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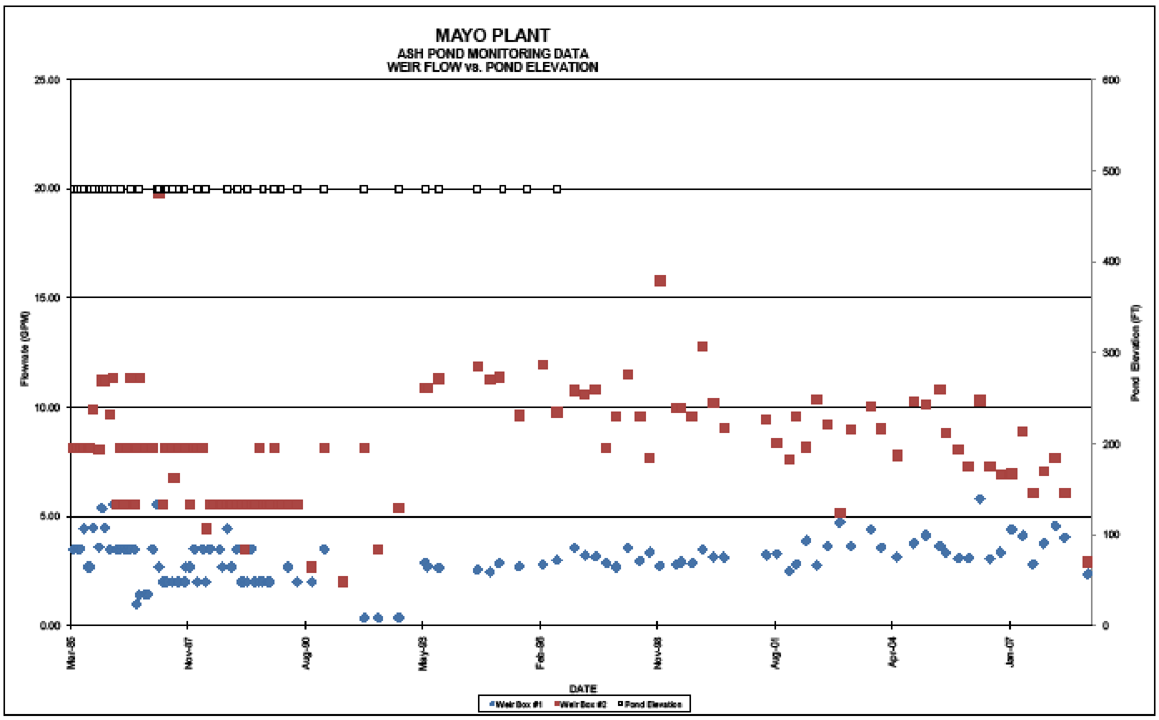
9.2.2 Instrumentation Monitoring Results

Data is recorded on a standard inspection report for Progress Energy. A copy is given to the manager of the Mayo Electric Generating Plant, and one additional copy is maintained in Progress Energy's files. Please refer to Appendix A, for sample reports. Piezometer readings recorded from March 1985 to May 2009 indicate a steady and consistent trend and are consistent with the design assumptions (see Section 7.1.3). The following chart represents seepage readings recorded from March 1985 to May 2009, for the east and west outlets of the internal drainage system, and indicate a consistent trend.



9.2.3 Evaluation

The historical data indicates that the embankment dam is performing adequately.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Inspection program is adequate.

9.3.2 Adequacy Instrumentation Monitoring Program

Instrumentation monitoring program is adequate.

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10.0 RESPONSE TO SPECIFIC EPA QUESTIONS

The following questions and answers are provided in conformance with EPA's Technical Directive (TDF) 5 regarding the reassessment of Coal containment Waste Impoundment Assessment Reports as a result of the TVA failure mode analysis report for the Kingston embankment failure. One of the key findings was that the Kingston unit may have failed because the embankment was built upon coal ash slimes.

1. Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

   The impoundment embankment was not built over wet ash or slag. Based on the Mayo E.G.P. Ash Pond Dam Geological Profile (Appendix A – Doc 02, Exhibit 27), no ash or slag was present at the time of embankment design or construction. Mayo E.G.P. Ash Pond Dam Typical Section (Appendix A – Doc 02, Exhibit 8), indicates portions of the embankment foundation are designed to be keyed into sound rock; however, no documentation has been provided to verify construction was in conformance with the design.

2. Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

   The dam assessor did not meet with or receive documentation from the design engineer of record regarding foundation preparation. Furthermore, no construction documentation was provided to determine if foundation preparation was in conformity with the design assumptions.

3. From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

   No evidence, of prior releases, failures, or patchwork was observed on the earthen embankment during our visual site assessment and no documents or statements were provided to the dam assessor that indicates prior releases, failures, or patchwork repairs have occurred.